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SOURCE

Le Petit Casablancais.SUBSOIL RESOURCES OF FRENCH MOROCCO

[Following are summaries of a series of articles on the subsoil resources of French Morocco written by Jean Sarrance and Pierre d'Aspe and published by the Casablanca weekly newspaper Le Petit Casablancais.

Numbers in parentheses refer to appended sources.]

MANGANESE

French Manganese Requirements

Iron ore in France contains, in general, too little manganese (only .5-percent manganese content in the Lorraine iron ore) for metallurgical treatment. France is faced with the impossibility of finding in its subsoil the 300,000 tons of manganese required each year by its metallurgical industry.

French Morocco is the only member country of the French Union capable of supplying France with such an amount of manganese. From this fact stems the great interest shown in the exploitation of French Moroccan manganese resources.

The French Moroccan deposits comprise the entire range of known manganese ores: rich ores (siliceous), poor ores (free of silica), rocky ores (difficult to utilize), and powdery ores, which must be conglomerated by calcination and sinterization.

Transportation Problem; Production and Exports

French Moroccan manganese ores, however, are faced with a severe handicap as far as the cost of transportation is concerned. Particularly the Imini and Tiouine manganese mines, located in the Ouarzazate region, a great distance from the centers of consumption, are faced with almost prohibitive transportation costs. In 1949, these costs accounted for 75 percent of the total price of manganese ore, FOB Casablanca.

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The reduction of this price depends essentially on lowering the cost of transportation, which at present can be effected by road only as far as Marrakech and by rail from there to Casablanca. In 1948, the crossing of the Atlas Mountains to Marrakech by way of the Tichka Pass alone added 3,500 francs per ton to the price of manganese ore. This figure must be even higher at present.

Thus, until 1947, the volume of manganese ore transported was relatively small, and French Morocco's total manganese production (including the Bou Arfa deposit) did not exceed an average of 80,000 tons per year. The urgent requirements of the French metallurgical industry demanded intensification of manganese ore production in the south of French Morocco. As a result, the Societe des Transports Miniers (Mining Transportation Company) was set up to organize the transportation of manganese ore. At present, this company has 150 Mack 10-ton trucks. Each day, two convoys of 20 trucks each make the run between Marrakech and the Imini and Tiouine mines (one convoy in each direction). In 1949, these trucks covered a total of 5 million kilometers and transported about 180,000 tons.

Manganese ore exports in 1949 came to 220,076 tons, distributed as follows: crude metallurgical ore, 125,429 (France); and chemical ore, 12,503 (France, 8,065; US, 1,316; Great Britain, 1,867; and Denmark, 1,000).

In 1950, French Morocco produced 257,775 tons of manganese ore, with a metal content of 115,225 tons. Of this amount, 143,917 tons were exported and 139,445 were treated in local plants, producing 107,585 tons of manganese sinter. This latter amount, plus 8,682 tons drawn from stocks on hand from the previous year, was exported.

In 1951, according to La Conjoncture Economique [monthly economic journal published in Rabat], French Moroccan production of metallurgical manganese ore amounted to 333,169 tons (containing 151,417 tons of metal) and 38,064 tons of manganese dioxide (containing 34,199 tons of metal). During that year, French Morocco exported 307,242 tons of manganese ore (not including manganese dioxide) valued at 3,283,174,000 francs; 274,112 tons were shipped to France and 33,124 to the US. Meanwhile, manganese dioxide exports amounted to 51,147 tons valued at 631,600,000 francs; 31,854 tons went to France, 10,000 to the US, and 4,320 to Germany.

During the first half of 1952, French Morocco mined 195,240 tons of metallurgical manganese ore (containing 90,200 tons of metal) and 18,500 tons of manganese dioxide.

Manganese ore production for the period from 1935 to 1948 was as follows (in tons):

<u>Year</u>	<u>Metallurgical Manganese</u>	<u>Chemical Manganese</u>
1935	24,806	56
1940	101,086	3,627
1945	42,174	3,118
1946	50,447	4,753
1947	103,340	5,963
1948	195,416	18,006

- 2 -

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RESTRICTEDTelpher Railway Projects

Despite everything, the removal of manganese ore from the mines by road remains difficult and very costly. Moreover, the wear and tear on trucks adds considerably to the total operating cost.

Owing to this situation, in 1938, a study was made of the possibility of removing the ore by way of a 54-kilometer telpher railway which would cross the Atlas Mountains into the Ourika Valley, and from there, the ore would be transported by regular railroad to Marrakech and Casablanca. Another project, which called for removal of the ore to Souss and Agadir, involved the construction of a 70-kilometer telpher railway leading to Aoulouz, from whence the ore would be shipped by truck to the port of Agadir. This latter project offered the advantage of removal of manganese ore to Aoulouz, not only from the Tiouine and Imini mines but also from those of Tasdremt. However, its success would depend a great deal on developing the port of Agadir, and this would not be to the liking of the people of Casablanca.

Complete study of this problem was resumed in 1948 and 1949 in the framework of the program for development of French Moroccan production of strategic materials, of which today the problem under consideration constitutes the fundamental element.

A plan calling for construction of a telpher railway across the Atlas Mountains in the direction of Marrakech by way of Tizi N'Tainant, and employing the Zat Wadi Valley instead of the Ourika Valley, was adopted and carried out. This solution was the easiest and least expensive.

Another solution has also been set forth for study. It calls for construction of a 13-kilometer road or railroad tunnel under the Atlas Mountains, between the Ourika and Zat Wadi valleys. However, this project would cost twice as much as the construction of a telpher railway. Moreover, it has the added disadvantage of not servicing the Tasdremt deposits.

Since 1950, there has been a definite trend toward construction of telpher railways. One of them is under construction now.

The successful operation of the French Moroccan manganese mines is based on two fundamental principles: (a) a large-scale increase in output; and (b) the maximum possible reduction of operating costs, which can be attained only through a reduction of transportation costs. The mine owners are really powerless to bring this about, for it is really up to the Protectorate government to develop and improve the country's means of transportation which have particular bearing on production of export commodities. (1)

Location of Principal Mines

The principal manganese mines are located in two large and quite distinct regions, as follows:

1. Eastern Morocco, which contains the deposits of Aquin, between Taourirt and Oujda, and those of Bou Arfa, located 230 kilometers to the south. The transportation difficulties mentioned above do not prevail in this region, which is well served by roads and railroads that run as far as the mines and make it possible to ship the ore to France at relatively low cost by way of the Algerian ports of Nemours and Oran.
2. The region south of Marrakech and the Great Atlas Mountains, between Quarzazate and the Upper Souss Valley, which contains the most important manganese mines and ore reserves in French Morocco. However, the difficulties encountered in transporting the ore to Marrakech across the Atlas Mountains add very considerably to operating costs.

- 3 -

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RESTRICTEDDeposits in Eastern Morocco

The most important deposits in eastern Morocco stretch along a 50-kilometer line along the Fes-Algeria railroad in the Taourirt area. The ore is found in lumps or thin layers embedded in Permian clay. It is of very good quality and has a metal content of 45-50 percent. Two mines are active at present: (a) the Narguechoun mine, which is located 5 kilometers southeast of Taourirt and is operated by the Societe Intermin (Intermin Company); and (b) the Tanourat mine, which is located near the railroad, midway between Oujda and Taourirt. Both mines are owned by the Societe Internationale Miniere du Maroc (International Mining Company of Morocco). The ore is mined by hand and shipped to France by way of Nemours. The known ore reserves are quite limited (150,000-200,000 tons). The combined output of these two mines amounts to approximately 800 tons per month. In 1949, the output of the Narguechoun mine totaled 6,172 tons, with no increases registered since then. In 1951, both mines produced a total of 5,100 tons of ore, with a metal content ranging from 40 to 47 percent.

The Bou Arfa mine is located 250 kilometers south of Oujda and is connected to the Algerian coast by the Bou Arfa-Oujda-Nemours railroad. The ore is found in lumps at Ain Berda and in lodes at Hamerouet and Hassi Fallot. The mine is owned and operated by the Societe des Mines de Bou Arfa (Bou Arfa Mining Company). Its present ore reserves are estimated at approximately 1,500,000 tons. The quality of the ore varies greatly throughout the deposit. In some areas, chemical dioxide of high quality is found, while in others (for example, at Ain Berda), where the largest known reserves are located, the ore contains only 30 percent manganese and 15 percent iron. On the other hand, it contains neither lead nor silica and for this reason is in great demand by the consumers.

The ore is enriched and concentrated locally in a plant located in the mining area. Following these operations, a marketable ore is obtained which has a manganese metal content of 36 percent.

The average monthly output of the Bou Arfa mine amounts to about 6,500 tons of metallurgical manganese and 800 tons of chemical manganese, shipped to Nemours over the Mediterranean-Niger Railroad. In 1951, the Bou Arfa mine produced 87,000 tons of manganese ore, 15,000 tons of which were calcined.

It is estimated that the output of manganese in eastern Morocco can be increased by 50 percent at the most.

Mines in Southern Morocco

The manganese mines of South Morocco are located either in Cambrian terrain, like the Touine mine, or in Cretaceous terrain, like the Imini mine. In the first case, the ore is rocky, and the deposits are irregular in formation; in the second case, the ore deposits are more regular in formation, but the metal is generally found in pulverized form.

Touine Deposit

This deposit is located 180 kilometers southeast of Marrakech, near the road leading to Ouarzazat through Tichka Pass. It consists of layers of a hard siliceous ore, with an average manganese content of 46 percent. It is exploited by the Compagnie de Tifnout-Tirani (Tifnout-Tirani Company) which belongs to a group controlled by the Omnium Nord-Africain (North African Omnium).

Although this deposit extends over an area of 10 kilometers, owing to its irregular formation, it is exploited only in three places, which cover an area of only a few hundred square meters each. Its present output amounts to 35,000 36,000 tons per year, and its known ore reserves are estimated at over one million tons.

- 4 -

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RESTRICTEDImini Deposit

This deposit, which is probably the most important manganese deposit in French Morocco, is located 15 kilometers north of the Tiouine deposit, on the southern slope of Tichka Pass. It is exploited by the Societe Cherifienne des Etudes Minieres (Sherifian Company for Mining Studies), which is a subsidiary of the Compagnie Mokta el Habib (Mokta el Habib Company). It is a subhorizontal deposit consisting of three layers, each between .20 and one meter thick, and extending over a 20-kilometer area along an east-west axis, between the Ouarzazate road and the Tidili Wadi Valley. In some places, the two lower layers are joined together, forming a single layer about one meter thick. In the Bou Tazoult area, the manganese vein is between 5 and 6 kilometers long, between 100 and 500 meters wide, and about one meter thick. The ore here has an average metal content of 51 percent but is pulverulent.

The known reserves of this deposit are estimated at 6 million tons. The annual output exceeds 125,000 tons of metallurgical manganese and 15 tons of chemical manganese. An ore enrichment plant built in 1949 increases this output to 150,000 tons annually. The ore is concentrated by sinterization in a plant at Sidi Marouf, near Casablanca, which is capable of processing 100,000 tons of ore annually. If necessary, this output can be doubled.

French Moroccan Manganese Output and Exports in 1951

The French Moroccan manganese ore output and exports in 1951 were as follows (in tons):

<u>Mining Concern</u>	<u>Mine</u>	<u>Output</u>	<u>Exports</u>
<u>Metallurgical Manganese</u>			
Societe des Mines de Bou Arfa	Bou Arfa	66,074	56,444
Societe Interminere	Narguechoun	6,172	5,461
Societe Cherifienne des Etudes Minieres	Imini	98,644	17,639
Omnium de Gerance Industrielle et Miniere (*1)	M'Koussa	9,713	8,005
Compagnie de Tifnout-Tirani	Tiouine	34,598	34,371
Societe Miniere du Sahro-Ougmar (*2)	Tiffernine	3,401	3,009
Societe Cherifienne des Mines (*3)	Glib en Nam	1,175	--
Societe Miniere des Ait Saoun (*4)	Tiffernine	520	500
Craig Stanton & Company	Tizgui and Lilane	1,580	--
<u>Chemical Manganese</u>			
Societe des Mines de Bou Arfa	Bou Arfa	1,150	30
Societe Cherifienne des Etudes Minieres	Imini	10,796	12,483 (*5)

(*1) Industrial and Mining Management Omnium

- 5 -

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- (*2) Sahro Ougmar Mining Company
- (*3) Sherifian Mining Company
- (*4) Ait Saoun Mining Company
- (*5) This figure includes stocks on hand from the previous year

Other Deposits

Less important French Moroccan manganese deposits are located at the following places:

1. Taskrem, where the ore reserves are estimated at 300,000 tons. The ore here has a high lead content.
2. M'Koussa, where development work has been under way for 3 years.
3. Anti Atlas Mountains (at Tifferine, Tisgui, Lilane, Tadgagalt, and Backoum), where the ore is of good quality but its known reserves are limited.

Exploitation of these deposits is hampered a great deal by the problem of transportation. (2)

COBALT

Ore Deposits

The only known cobalt deposits in French Morocco have been discovered in the Pre-Cambrian formations of Bou Azzer and Graara, in the Anti-Atlas Mountains, near Ouarzazate. At present, only the Bou Azzer and Aghbar deposits are being worked.

In contrast to Congolese cobalt, which is found together with copper and is produced only as a by-product, the cobalt found at Bou Azzer consists essentially of smaltite and amounts to 1.5 percent of the ore. Iron and nickel are also present in this ore, but in very small amounts (never more than one fourth of the cobalt content, except in rare cases). According to Edouard Lavergne of the Chambre Syndicale des Industries Minières du Maroc (Syndical Chamber of the Mining Industries of Morocco), the cobalt ore found at Bou Azzer also contains gold at the rate of between 50 and 100 grams per ton.

The marketable ore is graded and enriched up to a 12-percent cobalt content. It is exported from the port of Casablanca, which is located more than 500 kilometers from the mining sites. It is transported by truck from the mines to Marrakech and by railroad from there to Casablanca.

Problem of High Operating Costs

Exploitation of the Bou Azzer cobalt deposit entails a high cost of transportation, which, added to equipment and exploration expenses, brings the price of the marketed product above prevailing world market prices. In 1948, one ton of cobalt ore (cobalt content, 12 percent) sold for 72,000 francs, FOB Casablanca, or 600 francs for every kilogram of cobalt metal contained in the ore.

Such high prices obviously hamper exports, and as a result, some prospective markets are lost to French Moroccan cobalt. Nevertheless, the cobalt ore output at Bou Azzer amounted to 6,225 tons (metal content, 688 tons) in 1951, as compared with 3,500 in 1950 (metal content, 421 tons). The 1951 output was sufficient

- 6 -

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to meet French demands in full and even to export a certain amount to the US. To increase its output, the Bou Azzer mine was granted an ECA loan, payable in cobalt ore, and to be used to finance new mining equipment.

It is hoped that adequate practical measures will be adopted soon to remove the mineral ores of southern Morocco from the mining sites to the ports. More railroad and telfer railroad facilities are badly needed for marketing French Moroccan cobalt, manganese, and other minerals.

Technical Data on Bou Azzer Mine

In 1938, the Bou Azzer mine ranked third in the world from the standpoint of production capacity. Its record prewar month was June 1939, when an output of 600 tons of ore was registered. During the war and subsequent years, production dropped considerably, until it regained its normal prewar level in 1950. Part of the ore produced is shipped to the Societe d'Electro-Chimie d'Ugine (Ugine Electrochemical Company) in France; the remainder goes to Canada for refining and subsequent export to the US.

The Bou Azzer mine extends for about 40 kilometers and contains 80 known veins. Vein No 7 alone, considered as the most important, contains an estimated 150,000 tons of ore (cobalt metal content, 3,000 tons).

Meanwhile, it is anticipated that in the very near future, the Bou Azzer mine will produce 10,000 tons of marketable cobalt ore (metal content, 12 percent) annually. It has already increased its productive capacity considerably by the following means: (a) a gravimetric wash plant; (b) a flotation installation; (c) modernization of operating methods; (d) opening of a second mining site; and (e) an equipment program which has been under way for several years.

Production and Export Data

French Moroccan cobalt ore (metal content, 12 percent) production from 1932 to 1951 was as follows (in tons):

<u>Year</u>	<u>Volume</u>
1932	566
1933	600
1934	1,618
1935	4,163
1936	3,372
1937	5,283
1938	6,541
1940	5,212
1941	584
1942	21
1943	1,966
1944	2,030

- 7 -

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<u>Year</u>	<u>Volume</u>
1945	894
1946	1,693
1947	2,649
1948	2,094
1949	1,739
1950	3,509
1951	6,255

During the first half of 1952, production amounted to 5,322 tons (metal content, 576 tons). Stocks of mined ore on hand at the end of June 1952 amounted to 1,818 tons, as compared with 1,417 at the end of December 1951.

The Aubed, Tamdrost, Ait Amane, and Irtem deposits, which were being actively exploited before the war, have now been abandoned.

According to customs and the Direction de la Production Industrielle et des Minas (Directorate of Industrial and Mining Production), French Moroccan cobalt ore exports in recent years were as follows (in tons): 6,594 in 1939 (including 4,692 to Belgium and 1,838 to France), 1,566 in 1947 (1,355 to Belgium and 211 to France), 3,656 in 1948 (1,987 to Belgium, 1,350 to France, and 319 to Canada), 1,563 in 1949 (1,504 to France and 159 to Belgium), and 4,551 in 1950 (1,685 to France and 2,866 to Canada). During the first half of 1952, exports totaled 5,182 tons; they should amount to 10,000 by the end of 1952. It is very encouraging to note in this connection that 5 years ago, French Moroccan cobalt ore production for 1952 was estimated at only 6,000 tons. (3)

COAL

Djerada Deposit

The only coal deposit now being exploited in French Morocco is at Djerada, 58 kilometers southwest of Oujda. It is an anthracite deposit containing 85 percent carbon, 10 percent ash, and 5 percent volatile substances. The coal is easy to wash, but it contains a rather large amount (50-55 percent) of fines. The deposit was discovered by the Societe Cherifienne des Charbonnages de Djerada (Sherifian Coal Mining Company of Djerada), which worked it until the war. Since then, it has been exploited by the Charbonnages Nord-Africains (North African Coal Mining Company), a semiprivate firm whose principal stockholders are the Sherifian State, the French Republic, and the owners of the Societe Cherifienne des Charbonnages de Djerada.

The known carboniferous formations of the Djerada deposit extend 40 kilometers from north to east and 10 kilometers from north to south. Among them is a lower group of coal beds, between 40 and 70 centimeters thick. These are the only beds being worked at present. There are three workable basins (North Basin, South Basin, and Central Basin), separated by swells which run more or less along an east-west axis.

- 8 -

RESTRICTED

25X1A

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On the basis of the results of past and present prospecting operations, the total coal reserves of the Djerada deposit are estimated at 90 million tons. Of this total, 15 million tons are in the North Basin and its offshoots (the Sidi Brahim basins) and 70 million tons in the South Basin and its offshoots.

North Basin

Thus far, only the North Basin has been exploited on a continuing basis. During the past 20 years, it has yielded more than 2 million tons of coal. Its anthracite beds outcrop along its borders. Their maximum depth in the center never exceeds 150 meters. They slope gently in the northern section of the deposit and more sharply in the southern section. Coal is extracted in the center of the basin through a 150-meter-deep shaft and by winzes along its borders.

Until recently, the coal mined in the North Basin was removed by a 22-kilometer telfer railroad and transported by the Oujda-Bou Arfa railroad to the Guenfouda wash plant, whose present annual capacity is approximately 300,000 tons. The telfer railroad will be replaced by a regular railroad, which required the construction of a tunnel, more than 13 kilometers long, completed in 1951. Meanwhile, the present installations at Guenfouda will be expanded or replaced by others capable of greater output.

A concentration plant produces briquettes for the Chemins de Fer Marocains (Moroccan Railroads) and egg coal for ordinary consumption. Both these products consist of a mixture of Djerada anthracite and pit coal from the Kenatza Basin, Oran Department (Algeria).

South and Central Basins

Until 1939, coal production at Djerada averaged 100,000 tons annually. A maximum of 125,000 tons was attained in 1938. The North Basin could easily satisfy all local demands. Moreover, comparatively low-priced imported coal of excellent quality was available. However, during the war, French Morocco had to rely almost entirely on its own resources. As a result, an attempt was made to increase coal production at Djerada. The prewar coal output was increased by 40 percent, and by 1941, production had been raised to about 140,000 tons per year. During 1946 and 1947, the world coal shortage became acute, and to meet the requirements of its industrialization program, French Morocco had to draw even more heavily on its coal resources. In the framework of the French Moroccan long-range equipment plan, the Charbonnages Nord-Africains worked out a program intended to increase annual coal production at Djerada to 600,000 tons in 1952.

Since the North Basin alone obviously could not meet these requirements, it became necessary also to exploit the South and Central basins, which up to that time had not been tapped. Moreover, the Charbonnages Nord-Africains was not unprepared to work these two basins, because the question had been under consideration since 1938. Today, a new mining center is being established at Hassi Blabe in the South Basin. It will be even more important than that of the North Basin. It will have, inter alia, a 450-meter shaft, which has already been completed. Another shaft will be built in the eastern offshoot of the South Basin, which, in 1954, will replace the North Basin, whose reserves by then will have been completely depleted. Meanwhile, some winzes are being built in the Central Basin.

It is estimated that within 3 years, the entire potential of the Djerada deposit will begin to be exploited, with the coal output increasing steadily and progressively from year to year.

- 9 -

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25X1A

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Anthracite production at Djerada from 1930 to 1951 was as follows (in tons):

<u>Year</u>	<u>Volume</u>
1930	960
1931	5,665
1932	14,963
1933	27,279
1934	36,071
1935	52,696
1936	49,387
1937	107,150
1938	141,050
1939	115,000
1940	143,500
1941	139,874
1942	118,102
1943	102,292
1944	134,300
1945	178,000
1946	221,750
1947	268,500
1948	290,100
1949	341,417
1950	367,900
1951	393,900

During the first half of 1952, production came to 224,400 tons of washed coal, including 217,800 tons ready for sale. During the period in question, the average daily yield per pit worker was 515 kilograms, as compared with 494 in 1951 and 470 in 1950 (official statistics).

About half of Djerada's output is exported, for the most part to Algeria, Italy, and France. Meanwhile, increased domestic output of other sources of power (electric power and liquid fuels, in particular) has enabled French Morocco to reduce considerably its imports of high-grade coal from the US and Germany. The time will soon come when French Morocco will be self-sufficient in solid fuels.

- 10 -

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In 1950, 3,713 pit workers and 2,050 surface workers at Djerada produced 367,900 tons of anthracite, including 356,000 for immediate sale and the remainder for delivery in concentrated form (mixed with Kenadza pit coal). Anthracite exports totaled 162,000 tons, including 77,100 to Algeria, 11,800 to Tunisia, and 20,600 to France.

In 1951, 3,632 pit workers and 2,295 surface workers mined 393,900 tons of anthracite, including 379,700 ready for immediate sale and the remainder for use in the production of concentrates. Exports totaled 213,218 tons, including 61,761 to Algeria, 57,037 to Italy, 30,415 to France, 20,640 to Belgium, 11,452 to Yugoslavia, and 10,145 to the Netherlands.

French Moroccan coal consumption in 1950 came to 327,900 tons (including 121,900 tons of imports), distributed as follows: electric power plants, 80,000; railroads, 26,000; cement factories, 53,600; sugar mills, 21,100; phosphate plants, 26,300; and others 120,900. Coal consumption in 1950 was less than in 1949, when 340,000 tons were consumed, owing to increased electrification of the railroads. On the other hand, in 1950, power plants and cement factories increased their coal consumption to a considerable extent. Of the 121,900 tons of coal imported in 1950, 47,900 came from Germany; 31,800, from the US; 22,400, from Great Britain; and 18,000, from Algeria.

In 1951, French Moroccan coal consumption totaled 334,500 tons (including 126,700 tons of imports), distributed as follows: electric power plants, 83,000; railroads, 25,700; cement factories, 60,500; sugar mills, 15,000; phosphate plants, 24,000; and others 126,300. Imports included 74,000 tons from the US, 27,300 from Algeria, and 15,000 from France.

During the first half of 1952, French Morocco exported 81,600 tons of coal, of which 27,000 tons went to France and 33,000 to Algeria. Meanwhile, imports amounted to 102,000 tons, including 38,400 from the US, 9,600 from Great Britain, 1,400 from Algeria, and 2,400 from Germany.

At present, French Morocco lists France, Algeria, Tunisia, the Netherlands, Portugal, Czechoslovakia, the Belgium-Luxembourg Economic Union, Yugoslavia, and Israel among its coal customers. Other countries (Spain, for one) soon will join this group.

Latest Coal Discovery

Recent explorations made by the BRPM (Bureau des Recherches Minières du Protectorat, Mining Exploration Bureau of the Protectorate of French Morocco) in the eastern extension of the Djerada deposit have uncovered a new coal basin, known as the Tiouli Basin, and located between the railroads and highway between Oujda and Bou Arfa. It is too early, however, to estimate the reserves of this new basin. (4)

LEAD AND ZINCOre Reserves

A recent estimate places French Morocco's lead and zinc ore reserves at 1,500,000 tons of lead and one million tons of zinc. However, these figures very likely will be increased as a result of extensive explorations made during the past few years and still going on. In eastern Morocco, for example, a new lead and zinc ore-bearing area is being prospected. It contains about one million tons of lead. Zinc there is found in the form of blende in conjunction with galena.

- 11 -

RESTRICTED

25X1A

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As exploitation of these deposits continues, the blende content is found to be ever greater. It is now certain that within a few months, blende production will be equal to or even greater than lead production.

From the geological standpoint, French Morocco has three types of lead and ore deposits, as follows:

1. Vein deposits in primary terrain.
2. Replacement deposits in the calcite and dolomite formations of the Jurassic and Cretaceous systems.
3. Detrital deposits.

Importance of Replacement Deposits

French Morocco is particularly interested in its replacement of lead and ore deposits because they account for three-fourths of local production. Except in the event of discovery of substantial reserves in the Devonian formations of its Saharan area and in the vein deposits of the Taouz region, French Morocco's greatest hopes for lead production lie in its replacement deposits among the Lias formations in the Oujda-Azilal-Figuig triangle. The well-known Mibladen deposit of the Societe des Mines d'Aouli (Aouli Mining Company) is located in this region, near Midelt.

Equally rich in lead deposits are the lower strata of the Jurassic Basin, extending from the area northeast of Midelt to the French Moroccan-Algerian border. There are two main lead-bearing centers as follows: (a) Bou Beker, exploited by the Societe des Mines de Zellidja (Zellidja Mining Company); and (b) Touissit, owned by the Compagnie Royale Asturienne des Mines (Royal Asturian Mining Company). Both of these centers are located south of Oujda.

The calcite formations of the Great Atlas Mountains also contain many deposits, the most important of which is that of Bou Dahar, which is located on the Aissa Wadi, about 50 kilometers northeast of Bou Denib, and is worked by the Societe Miniere du Haut Guir (Upper Guir Mining Company).

Vein Deposits

The vein deposits are found for the most part in schistous terrain. The primary vein system of the Aouli mines is located at Midelt, only a few kilometers from the Mibladen replacement deposit. The central section of the Great Atlas Mountains, south of Marrakech, contains the Ouichedden deposits, which are exploited by the Societe Miniere de Gundafa (Gundafa Mining Company); the Assif el Mal deposits near Amizmiz; and the Erdouz deposits, located on the northern slope of the Tizi N'Test Mountains.

More or less important lead and zinc deposits are also located in many other regions, including the following: Rehamna, between Marrakech and Settati; Djebilet; central Morocco; Tazekka (Rahal el Larbi; Sidi bou Othmane, 30 kilometers north of Marrakech; Djebel el Aouan, a few kilometers north of Khenifra; and Djebel Chiker, 10 kilometers south of Taza).

Aside from the Aouli Mines, lead and zinc vein deposits in French Morocco are less well known and appear to have smaller reserves than the replacement deposits.

- 12 -

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RESTRICTEDPostwar Output of Lead Mines

After a period of stagnation during the last war, a sharp increase in activity has taken place in the French Moroccan lead mines since 1947. Some statistics on marketable lead ore (70-percent metal content) production follow (in tons):

<u>Year</u>	<u>Volume</u>
1930	7,404
1936	10,260
1940	30,739
1945	15,451
1946	15,301
1947	29,162
1948	39,183
1949	60,000
1950	65,874*

*Containing 48,213 tons of metal

In 1951, marketable lead ore production amounted to 93,180 tons, containing 68,184 tons of metal. During 1952, it amounted to 54,396 tons, containing 41,784 tons of metal. July 1952 production came to 9,696 tons of ore, containing 7,033 tons of metal.

Exports amounted to 51,902 tons in 1950 and 54,454 in 1951, according to official statistics published in the 1951 special annual issue of Conjoncture Economique Marocaine.

The lead mines employed 32,885 workers in 1950 and 36,556 in 1951.

According to the estimates of French Morocco's long-range equipment program, lead production should exceed 110,000 annually by 1953.

Principal Deposits

In 1951, the Bou Beker deposit yielded 38,000 tons of lead ore (74 percent metal content), 35,000 tons of which were sent to the Oued el Heimer foundry, and 30,000 tons of zinc ore (54 percent metal content). There are two wash plants which treat a total of about 3,500 tons of ungraded ore daily. New equipment to be installed is expected to increase this output to 4,500 tons daily. In terms of marketable ore, the reserves of the Bou Beker deposit are estimated at 850,000 tons of lead and one million tons of zinc.

In 1951, the Touissit deposit yielded 18,000 tons of marketable lead concentrates (70-percent metal content) and 1,000 tons of zinc ore (37-percent metal content). In terms of concentrates, the reserves of this deposit are estimated at 100,000 tons of lead and 30,000 tons of zinc.

Also, in 1951, the Aouli vein deposit and the Mibladen mine yielded 17,000 tons of lead ore concentrates (75-percent metal content).

- 13 -

RESTRICTED

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During the same period, the Bou Dahar deposits yielded 3,300 tons of lead ore concentrates (72-percent metal content). The reserves of these deposits are estimated at 60,000 tons of marketable ore concentrates.

Meanwhile, the Rehamna deposits of the Societe Miniere de l'Atlas de Taouz (Taouz Atlas Mining Company) yielded about 1,800 tons of lead ore concentrates (50-percent metal content).

Other deposits worthy of note are the Ouicheddem and Djebilet vein deposits in the Marrakech region; the Bab Cedre and Djebel Tazzeke vein deposits in the Taza region; and the Goulmena and Ksar el Souk replacement deposits, which are still under exploration.

Foundries

Until recent years, all the French Moroccan lead ore concentrates were exported to French and Tunisian (Megrine) foundries. Paradoxically, French Morocco had to import the soft lead it needed, particularly from Tunisia. Confronted with this situation, the Pennaroya and Zellidja companies established the Ouel el Heimer foundry, equipped with Newman furnaces, which began operations in 1947. It produced 9,600 tons of industrial lead in 1949 and 12,096 in 1950. Since then, the foundry's capacity has been doubled by the construction of a Dwight Lloyd hearth. Already, an annual output of between 60,000 and 80,000 tons is foreseen. A lead-refining and silver-removing shop was put in operation in January 1951. (5)

COPPER

General Remarks

At present, French Morocco does not produce large quantities of copper. Thus far, explorations have not yielded the results that had been hoped for. Nevertheless, there is copper to be found in French Morocco, although the known deposits are generally considered as too meager for exploitation on an industrial scale. During the war, owing to the failure of copper imports, the government encouraged exploitation of local resources, particularly with a view to producing copper sulfate, which is absolutely indispensable for French Moroccan agriculture. Local production, which was next to nothing in 1940, totaled 9,200 tons of copper ore concentrates (containing 2,500 tons of metal) during the period 1941-1949, principally accounted for by the Azegour mines. However, in 1950, with the return of normal import conditions, these mines suspended operations, largely because their production costs were too high.

Many new copper prospecting operations are now under way in the Atlas Mountains, notably in the Djebel Sahro area. The best results have been obtained in the Bou Skour vein, 30 kilometers southeast of Skoura, where the reserves of ungraded ore are estimated at 1,250,000 tons, with a 2.5 percent copper metal content. The necessary capital is being currently collected to finance a mining company to exploit these resources. Information is not yet available on the extent and potentialities of the other copper deposits in the Djebel Sahro area (Tatelt, Tanoufit, Foun Zguigui, and Fou Gaffer), which were discovered in 1950, and on those in eastern Morocco (Argana, Bigoudine and Ourika).

Activity in 1951

In 1951, only the following copper deposits were being worked in French Morocco (including prospecting operations):

1. Agadir Region

Argana, Ait Ktat, Bigoudine, and Tazalagaht (BRFM); Boulbaz (Societe Marocaine de Commerce et d'Investissements, Moroccan Trading and Investment

- 14 -

RESTRICTED

25X1A

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Company); Tizi N'Test (Compagnie Miniere de Souss, Souss Mining Company, and BRPM); and Tirkou (Societe Industrielle et Miniere du Sud, Southern Industrial and Mining Company).

2. Marrakech Region

Azegour (Societe de Molybdene, Molybdenum Company); Bou Skour (Societe des Mines de Bou Skour, Bou Skour Mining Company); Bou Gaffer (Societe des Mines de Bou Gaffer, Bou Gaffer Mining Company); Fom Zguigui and Tanoufit (Societe d'Etudes et d'Exploitations Minieres du Sahro Central, Central Sahro Mining Studies and Operations Company); Ounein (Societe Miniere des Gundafa); Ourika (Societe Ourika, Ourika Company); Sidi Rahmon (Societe Miniere des Abda Amar, Abda Amar Mining Company); Assif N'Tirhli (Societe Somidet, Somidet Company); and Tadelit (Compagnie Miniere du Sahro Sud, Southern Sahro Mining Company).

3. Oujda Region

Djebel Klakh (Societe Marocaine d'Exploitations Minieres, Moroccan Mining Operations Company).

It must be noted, however, that operations at all these mines are still in the exploration stage, so much so that their total copper ore output in 1951 amounted to only 47 tons, according to Bulletin d'Information du Maroc, Vol VI, No 3. The Djebel Klakh deposit accounted for most of this output.

French Moroccan copper ore production from 1940 to 1950 was as follows (in tons):

<u>Year</u>	<u>Ore</u>	<u>Metal Content</u>
1940	90	25
1941	456	134
1942	1,065	276
1943	872	212
1944	2,078	580
1945	1,195	344
1946	240	70
1947	168	45
1948	1,794	500
1949	1,287	360
1950	70	18

Present Situation

French Morocco is still compelled to import practically all the copper it needs. Its principal suppliers are France and Algeria; other suppliers include the Netherlands, the Belgium-Luxembourg Economic Union, and Great Britain. (6)

- 15 -

RESTRICTED

25X1A

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IRON

General Remarks

There are many iron ore deposits throughout French Morocco. However, they are too scattered and often accessible only with great difficulty. Moreover, local metallurgical treatment of the ore is not possible, owing to the fact that there are no adequate coal resources within easy reach. It is said that new methods are being sought to make possible on-the-spot metallurgical treatment of French Moroccan iron ore, but at present, this endeavor is still only in the study phase.

Production since 1938

The French Moroccan iron ore production index dipped sharply from 100 in 1938 (base year when the European metallurgical industry became interested in French Morocco's iron ore resources and some iron mines were put in operation, notably the Ait Amar mine in the Oued Zem area) to 48 in 1946. Then, the index rose to 59 in 1947, 115 in 1948 and 136 in 1949, dropped to 122 in 1950, and rose to the all-time high of 208 in 1951.

Marketable iron ore production amounted to 319,190 tons (containing 146,542 tons of metal) in 1950 and 545,434 (containing 246,968 tons of metal) in 1951.

At present, the Ait Amar and Kettara mines are practically the only French Moroccan iron mines in operation. The Ait Amar iron ore deposit is owned by the Societe Marocaine des Mines et Produits Chimiques (Moroccan Mining and Chemical Company), whose main offices are located in Casablanca. The deposit is located 25 kilometers north of Oued Zem and is connected to Casablanca by a 180-kilometer railroad which also runs to the mining center of Khourigba. The ore contains, among other things, 46 - 48 percent iron, 12 - 14 percent silica, and .6 percent phosphorus.

The known iron ore resources of the Ait Amar deposit are estimated at about 6 million tons.

Other Known Iron Ore Deposits

There are two main types of deposits, as follows:

1. Sedimentary deposits, which are located for the most part in Silurian and carboniferous regions and include the following: Khaloua, near Bou Regreb, 50 kilometers east of Rabat; Boulhaut, 50 kilometers from Casablanca (probable reserves, 10 million tons of ore, with a metal content of between 40 and 45 percent); Beni Khirane, north of Ait Amar (probable ore reserves, 5 million tons); Ouled Said, in the Mazagan region (probable ore reserves, 30 million tons of low-quality ore, with a high silica content); Djebel Tachilla and Ouarzanime, in the Tiznit region (reserves estimated at 400 million tons of ore, containing from 30 to 40 percent iron and from 15 to 30 percent silica); Ougnat, east of Djebel Sarho (known reserves, 10 million tons of ore, containing 55 percent iron); Djebel Mahseur, 20 kilometers south of Oujda (known reserves, 1,500,000 tons of ore, containing 42 percent iron and 13 percent silica).

2. Replacement deposits, which are located, as a rule, in calcareous areas. The most important are Khenifra, where hematite is found in combination with barytes (probable ore reserves, about 60 million tons, containing 43 percent iron, 10 percent silica, and 15 percent barytes); Tiflet, in the Rabat region (probable ore reserves, greater than at Khenifra); Ait Hamra, Ain Keab, Ain Kroub,

- 16 -

RESTRICTED

25X1A

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and Maidnet Moualinear Rhaba Ank, in the Boulhaut region; Tidsi, in the Agadir region (known ore reserves, 500,000 tons); Agadir-Ferrieres (known ore reserves, 800,000 tons); Kettara, worked by the Compagnie Miniere et Metallurgique (Mining and Metallurgical Company) of Casablanca; and Sidi Makhoulouf, near Sidi bou Othmane, northeast of Marrakech.

Principal Deposits Worked

According to the Division of Mines and Geology of the Directorate of Industrial Production and Mines, the principal iron ore deposits now being actively worked in French Morocco are as follows:

1. Tachilla and Ouarzmine, by the Societe d'Etudes Miniere de l'Ouarzmine (Ouarzmine Mining Study Company), which has main offices in Casablanca.
2. Boulhaut, owned by Henri Chevrier.
3. Sabri and Dalaa, by the Societe Cherifienne des Mines, which has main offices in Rabat.
4. Kettara, by the Compagnie Miniere et Metallurgique.

Export Data, 1948 - 1951

French Moroccan iron ore exports, for the most part, go to Great Britain and the Netherlands. In 1948, Great Britain purchased 262,843 tons out of a total of 271,707. In 1949, out of a total of 332,714 tons, Great Britain purchased 223,091 and the Netherlands, 100,000. In 1950, all exports went to Great Britain (278,470 tons) and the Netherlands (11,230 tons). In 1951, they went to Great Britain (284,713 tons), the Netherlands (223,215 tons), and Germany (36,645 tons). Exports during the first half of 1952 totaled 283,000 tons. (7)

ANTIMONYDeposits and Output

Antimony mining began in French Morocco on a small scale in 1935. By 1949, according to the Mining and Geological Service, 12 antimony deposits were being exploited. In 1947, the output of stibnite (between 55 and 60 percent metal content) totaled 806 tons. This amount increased to 894 tons in 1948, 1,202 in 1949, 1,217 in 1950, 1,742 in 1951, and 870 during the first half of 1952.

The stibnite extracted is sorted and washed on the spot, and it is enriched so that the product sold commercially has a metal content of about 65 percent. However, its value is often reduced by the fact that it contains some lead.

The French Moroccan antimony deposits are located, for the most part, in central Morocco, particularly in the Kenifra area. In 1951, 14 of these deposits were considered as being actively worked. The most important of these were as follows:

1. The Ain Koheul deposit, located north of Tedders.
2. The Tazzeka group of deposits (Bougada, Bougagout, Ich ou Mellal, Masser Amame, and Tourtit), located in the Fes region; these are vein deposits embedded in primary schists.
3. The M'Rirt Sud group of deposits (Tirza and Mgued'h), located in the Meknes region; these are found in microgranitic rocks.

- 17 -

RESTRICTED

25X1A

RESTRICTED

4. The Bled Zaian group of deposits (Timmerdoudine, Mouhajibat, Abeurkrit, and others), located in the Meknes region; these are found in microgranitic rocks.

5. The Smala group of deposits (Souala and Enta Botma), located northeast of Oued Zem in the eastern part of the Casablanca region.

Increased world demand for antimony, particularly since 1951, has caused antimony mining to increase in French Morocco. However, modern equipment and methods are needed to increase the output and improve the quality of the product marketed.

Exports

Until 1950, the principal purchasers of French Moroccan stibnite were France, Great Britain, Italy, and the US. Exports in 1950 were as follows (in tons): France, 966.5; Italy, 115; Great Britain, 81.3; US, 89; Belgium, 47.6; and Algeria, 1.4. Exports in 1951 amounted to 1,750.5 tons, valued at 147,397,000. The principal purchasers were as follows (in tons): France, 807; Great Britain, 636; Italy, 107; US, 54.4; Netherlands, 119; and the Belgium-Luxembourg Economic Union, 24.5. (8)

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ASBESTOS

General Remarks

French Morocco became interested in exploiting its asbestos resources in 1940, because imports ceased abruptly as a result of the war. The explorations carried out in the Anti-Atlas Mountains region led to the discovery of chrysotile deposits in the Bou Azzer area. Exploitation was begun at the Bou Oufroh deposit. The asbestos produced there is of excellent quality, but production costs are very high, owing in part to the lack of modern equipment and the difficulties encountered in transporting the ore to Casablanca, where it is used industrially or shipped abroad.

Another important chrysotile deposit was discovered at N'Kob, 30 kilometers west of Tazzenakkt. Moreover, an important deposit of rather mediocre asbestos was found in the cobalt-bearing area of Aghbar. Nevertheless, this deposit will be exploited to offset the loss of the Bou Oufroh deposit, which is nearly exhausted.

Data on Output and Currently Active Mines

French Moroccan asbestos production during the period from 1942 to 1951 was as follows (in tons):

<u>Year</u>	<u>Volume</u>
1942	166
1944	507
1947	787
1948	399
1949	402
1950	511
1951	678

- 18 -

RESTRICTED

25X1A

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The upward surge of production in 1951 is particularly encouraging. It is anticipated that the situation will improve even further as soon as current equipment and transportation problems are adequately solved.

The asbestos mines currently active in French Morocco (including those where only prospecting operations are now under way) are as follows:

1. Bou Oufroh, owned by the Societe Miniere de Bou Azzer et du Graara. (Bou Azzer and Graara Mining Company).
2. N'Kob, operated by the Societe Miniere de Siroua (Siroua Mining Company), with main offices in Casablanca, and the BRPM.
3. Djebel Irguishem, owned by the Societe Miniere de Bou Azzer et du Graara.
4. Agouni N'Id ou Illoun, owned by Jacques Evers of Casablanca.
5. Tif Dra, which is under the supervision of the BRPM.

All of these mines are located in the Anti-Atlas region, bordering on the Marrakech region.

Import and Export Data

In 1950, French Morocco imported asbestos from the following countries (in tons): Union of South Africa, 338.8; Canada, 113.5; British Africa, 22; and France, 4.8. During the year, French Moroccan asbestos exports totaled 156.8 tons (126.8 to France and 30 to Algeria).

In 1951, asbestos imports were valued at 57,875,000. The countries of origin were as follows (in tons): Union of South Africa, 425.8; Canada, 173; France, 109; and the US, 45. Meanwhile, exports totaled 158.2 tons, valued at 17,205,000 francs. Some of the countries of destination were (in tons): US, 109; Austria, 5.2, and France, 2.2.

OTHER RESOURCES

Tin

Despite the importance of tin in modern industry and the constant increase in demand, French Moroccan tin ore production was practically nil in 1950. In 1951, cassiterite exports also amounted to practically nothing.

The tin ore deposits in the Oulmes region consist of veins embedded in a granitic massif and fall into the following categories:

1. Vein deposits.
2. Eluvial deposits (breaking up of the veins by atmospheric agents).
3. Alluvial deposits (breaking up of the veins by wadis).

The only tin mine currently in operation in French Morocco is the El Karit mine, near Oulmes. It consists of cassiterite-bearing quartz veins. Cassiterite production at this mine totaled 400 tons during the period from 1934 to 1946. This rate of output has decreased considerably since the war. In fact, in 1948, there was almost no output. Some work, however, was resumed in 1951, when the small smelting furnace at the mine treated 22 tons of ore.

- 19 -

RESTRICTED

25X1A

RESTRICTEDMolybdenum

Molybdenite, until recent years, was extracted at the Azegour mine. However, the attention of this mine has recently been turned to the extraction of chalcopyrite. Molybdenite prospecting is now going on in the northern section of the mine (Tisqui area) and in the Tichka Massif, with a view eventually to mine this ore. From 1948 to 1950, no molybdenite was exported because of the very low quality of the ungraded ore produced (molybdenum content, .02 percent). However, in 1951, according to available customs statistics, 60 tons were exported to France.

Wolfram

Since 1948, the BRPM has been carrying on wolfram prospecting operations in the Hassian ed Diab area, near Berguent, in eastern Morocco, but it is still too early to estimate the industrial value of the ore deposit in question.

The Societe du Wolfram (Wolfram Company) also engaged in similar prospecting operations at the end of 1950 in the Zguit area (Rabat region), but here again, it is still too early to estimate the possibilities of any ore discoveries made.

Barytes

French Moroccan production of barytes, which started in 1949, amounted to 5,000 tons in 1950 and 3,256 in 1951. At present, the Djebel Ighoud deposit, located 70 kilometers from Safi, accounts for all French Moroccan output of barytes, except one tenth of the total, which comes from a small mine located in the Tichka area. About one third of the total output is sold on the local market for use in the oxygen industry.

In 1951, 634.4 tons of barytes, valued at 1,084,000 francs, were exported to Great Britain.

Beryl

French Moroccan beryl production from 1948 to 1951 was as follows (in tons): 51 in 1948; 160 in 1949; 56 in 1950; and 84 in 1951. The regression registered after 1949 was brought about by the fact that the mining company concerned (Societe Miniere des Zenegas, Zenegas Mining Company) has turned its attention to newly discovered beryl-bearing areas, while awaiting the arrival of additional equipment with which to carry on and expand its original operation.

Beryl in French Morocco is found in irregularly distributed lodes of several tons. Its beryllium oxide content is about 12 percent.

Fluorite

French Morocco has two main fluorite mines (Zraïna in central Morocco and Djebel Tirremi in eastern Morocco), whose output increased sharply from a few tons in 1950 to 1,968 tons in 1951. In 1951, French Morocco exported 548.2 tons of fluorspar (including 500 tons to the US) valued at 3,953,000 francs.

Vanadinite

Vanadinite in French Morocco is found in some lead ore veins in the Taouz area. During the period from 1940 to 1944, French Morocco produced 163 tons of vanadinite. New prospecting operations have since been undertaken to reactivate mines which are now at a standstill.

- 20 -

RESTRICTED

25X1A

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At present, the only active French Moroccan graphite mine is located at Frag el Ma, near Sidi bou Othmane, 30 kilometers north of Marrakech.

French Moroccan graphite occurs in lodes or beds among metamorphic schists. Total production until 1950 amounted to 10,000 tons, with a carbon content of between 45 and 50 percent. Production for the period from 1948 to 1951 was as follows (in tons): 284 in 1948; 72 in 1949 (sharp decline due to competition from Italian graphite); 74 in 1950 and 131 in 1951. During the past year, exports amounted to 65,188 tons (55,188 to France, 5 to Algeria, and 5 to Tunisia) valued at 1,473,000 francs.

Graphite production and exports in French Morocco could be considerably increased by the acquisition of modern equipment, which would reduce production costs to a great extent.

Mica

The Pre-Cambrian formations in the Zenagas area, south of Tazenatcht, contain pegmatite beds with muscovite mica deposits.

These deposits were known long before the war, but it was not until 1946 that a small company began to work one of them on a limited scale. A new company has been carrying on prospecting operations since 1948. Production during the period from 1948 to 1951 was as follows (in tons): 144 in 1948, 54 in 1949, 74 in 1950, and 25 in 1951. Use of modern equipment undoubtedly would increase production considerably.

In 1950, French Morocco exported 142.3 tons of mica in blocks and pieces to the US and 1.8 tons of pulverized mica to France. Exports in 1951 amounted to 116.7 tons in blocks and pieces (including 102.2 tons to the US) valued at 854,000 francs. (9)

Gold

Gold is found in French Morocco, but it is still questionable whether its production can be made profitable.

Until 1950, gold in this country was obtained from the metallurgical treatment of cobalt ore mined at Bou Azzer, in the Anti-Atlas region. The gold content of the marketable ore used for this purpose was as high as 200 grams per ton. During 1950, about 70 kilograms of gold were produced in this manner.

In 1950, the Tiouit gold-bearing quartz mine, located south of Boumalne in the Sarho region, was equipped with a small cyaniding plant whose daily capacity is estimated at between 20 and 30 tons of quartz, containing about one kilogram of gold and between 2 and 3 kilograms of silver.

In 1951, according to official statistics, French Morocco produced 3,322 kilograms of gold.

The Tiouit mine is owned by the Compagnie Miniere du Djebel Mansour (Djebel Mansour Mining Company), whose main offices are located in Casablanca. The Bou Azzer mine is owned by the Societe Miniere de Bou Azzer et du Gaara.

Silver

There are two major silver-bearing ore deposits in French Morocco. They are the Bou Azzer deposit (Vein No 5, discovered in 1947, while prospecting for cobalt) and the Tiouit deposit, whose ore contains four times as much silver as gold.

- 21 -

RESTRICTED

25X1A

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However, a large part of the silver output of French Morocco comes from its galena mines, where the silver content ranges from 3 to 400 grams per ton of galena concentrate, containing 70 percent lead. In 1950, the amount of silver contained in the ore produced was estimated at approximately 20,000 kilograms.

A desilverization plant was established recently at Oued el Keimer, near the Bou Beker mines, in the foundry of the Zellidja-Pennaroya Company.

In 1951, French Morocco produced 64,352 kilograms of silver.

Marble

At present, marble in French Morocco is quarried principally in the Casablanca, Agadir, Rabat, and Taza regions. Some of the more important quarries are those of Oued Yquem (gray and black-veined marble) and Oued Ackreuch (red marble) in the Rabat region; Boured and Sidi Megher in the Taza region; Bou Aciba and Oued Kauch in the Meknes region, and Achacha in the Agadir region.

French Moroccan total marble production declined from 40,000 tons in 1949 to between 12,000 and 15,000 in 1951.

There are seven large marble-cutting establishments in French Morocco, four of which are located in Casablanca and the other three in Rabat and Agadir. The oldest of these establishments is the SIMO Societe Industrielle des Marbres Ouvres (Industrial Marble-Cutting Company) which operates the Oued Yquem quarries.

In 1950, French Morocco exported 195.3 tons of uncut marble and 35.1 tons of cut marble (to Great Britain); in 1951, these exports amounted to 1,185.8 and 56 tons respectively.

Gypsum

French Morocco has many deposits of high-quality gypsum. In fact, it is estimated that French Morocco could supply all the gypsum needed by Europe. However, gypsum in French Morocco is extracted principally in the Safi region to take advantage of the proximity of this modern port.

Other known deposits include the following: Oued Mellal, near Casablanca; Azemmour - Sidi Said Machou; Asni (being exploited); Ouezzane (being exploited); Taouirirt (being exploited to a limited extent); Ouled el Hadj, near Fes (being exploited by the Corporation des Platriers, Plasterers' Guild); Mikkes, in the Fes region; Timhadit, in the Little Atlas region; Naour, in the Agadir region; Jmin Tanout; Middelt, where there is gypsum, as yet not exploited, which can be made into a plaster equal if not superior in quality to plaster of Paris; Souk es Sebast, Sidi Tigi, Sidi Teit in the Safi region; and Sidi bel Kraara in the Saidia region.

Many of these deposits are exploited only to supply the needs of local plaster factories, because prohibitive transportation costs and their relatively great distance from any port prevent the export of gypsum in large quantities. During the period from 1947 to 1951, French Moroccan gypsum exports were as follows (in tons): 25,651 in 1947; 28,333 in 1948; 21,178 in 1949; 8,631 in 1950; and 11,436 in 1951. During this same period, plaster exports amounted to 104.4 tons (including 99 to French West Africa).

Clay and Smectite

Clay has been used in French Morocco for centuries in such important and traditional industries as pottery, ceramics, and brick making.

- 22 -

RESTRICTED

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At present, there are 21 brickworks, located for the most part in the Casablanca and Rabat areas. They already produce sufficient brick of the ordinary variety to satisfy the entire domestic demand. Most of them now have modern equipment, and it is anticipated that their output will increase considerably.

French Morocco has many high-quality clay deposits. Production for the period from 1947 to 1951 was as follows (in tons): 66,000 in 1947; 78,000 in 1948; 89,000 in 1949; 145,000 in 1950; and 170,000 in 1951.

French Morocco also has many ceramic works, particularly at Safi, Sale, and Fes.

Smectite deposits have been found near Taourirt, in eastern Morocco. The principal ones are those of Gara Ziad, Bled Zerga, and Ank Jemel. The Bled Zerga deposit, located 7 kilometers southeast of Taourirt, has been worked for several years by the Raffinerie Cherifienne d'Huiles de Petrole (Sherifian Paraffin Refinery) of Casablanca. The reserves of this deposit are estimated at approximately 300,000 tons of high-quality smectite.

During the period from 1949 to 1951, smectite production in French Morocco was as follows (in tons): 4,200 in 1949; 5,664 in 1950; and 8,883 in 1951. It is hoped that in a few years, the annual output can increase to 30,000 tons. (10)

The 6 December issue of Le Petit Casablancais stated that phosphates, petroleum, and salt were not covered in this series of articles, because special articles have been or will be devoted to these items at some later date.

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- E N D -

- 23 -

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